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In situ benthic flux measurements of DIC and alkalinity over two years of Ocean Alkalinity Enhancement (OAE) additions to a coastal estuary.

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Many Ocean Alkalinity Enhancement (OAE) strategies involve the addition of alkaline mineral particles to natural waters, where they will dissolve and increase alkalinity. However, a portion of the added material may settle to the seafloor and dissolve within the sediments instead of the overlying water. Because coastal sediments may naturally produce alkalinity, either through anaerobic remineralization or calcium carbon dissolution in the porewater, distinguishing background alkalinity fluxes from those generated by OAE materials is essential for accurate monitoring, reporting, and verification (MRV) and assessing potential impacts on sediment carbonate cycling. To address this challenge, we conducted 34 benthic lander deployments for a total of 68 *in situ* benthic fluxes of dissolved inorganic carbon (DIC), and total alkalinity (TA) between 2022-2024, during a two-year OAE field trial in a coastal estuary (Bedford Basin, NS, Canada) that received additions of alkaline mineral feedstock. The Gothenburg Small Benthic Lander was deployed in both spring and fall to capture the seasonal hypoxia cycle, at sites located closer and further away from the OAE addition area, and across a depth gradient. At shallower depths sediments were a source of DIC and TA fluxes were near zero with the exception of near the OAE addition site which was a source of TA. Fluxes were relatively constant between seasons. At the deeper station, sediments were a source of both DIC and alkalinity and were highly spatially variable. There appeared to be little change in fluxes over the two-year OAE addition period, which could suggest little interaction between the feedstock and the sediments, but could also be due to a mismatch between the timescale of the trail and the benthic response.